embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the description.

[0098] The Abstract of the Disclosure is provided to comply with 37 CFR § 1.72(b) and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, various features may be grouped together or described in a single embodiment for the purpose of streamlining the disclosure. This disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter may be directed to less than all of the features of any of the disclosed embodiments. Thus, the following claims are incorporated into the Detailed Description, with each claim standing on its own as defining separately claimed subject matter.

[0099] The following documents contain additional information that may be used in implementing various aspects of the present teachings: (1) Neubauer et al. "Clinical Feasibility of a Fully Automated 3D Reconstruction of Rotational Coronary X-Ray Angiograms," *Circ. Cardiovasc. Interv.,* 2010, 3, 71-79; (2) Tak. "Ejection Fraction Derived by Noninvasive Modalities Versus Left Ventricular Angiographic Determination," *Clinical Medicine & Research,* 2005, 3, No. 2: 61-62; (3) Molloi et al. "Regional Volumetric Coronary Blood Flow Measurement by Digital Angiography: In Vivo Validation," *Acad. Radiol.,* 2004, 11, No. 7, 757-66; (4) Grinberg et al. "Modeling Blood Flow Circulation in Intracranial Arterial Networks: A Comparative 3D/1D Simulation Study," *Annals of Biomedical Engineering,* 2011, 39, No. 1, 297-309; (5) Itu et al. "A Patient-specific Reduced-order Model for Coronary Circulation," *IEEE International Symposium on Biomedical Imaging*, Barcelona, Spain, May 2012; (6) Schuurbiers et al. "In vivo validation of CAAS QCA-3D coronary reconstruction using fusion of angiography and intravascular ultrasound (ANGUS)," *Catheter Cardiovasc. Interv.,* 2009, 73, No. 5, 620-626; (7) U.S. patent application Ser. No. 13/794,113 filed Mar. 11, 2013 entitled "Method and System for Non-invasive Functional Assessment of Coronary Artery Stenosis" (Attorney Docket No. 2012P05770US01); (8) International PCT patent application no. PCT/US2013/030732 filed Mar. 13, 2013 entitled "Framework for Personalization of Coronary Flow Computations during Rest and Hyperemia" (Attorney Docket No. 2012P06278US); (9) Toino et al., "Fractional flow reserve versus angiography for guiding percutaneous coronary intervention," *New Engl. J. Med.,* 2009, 360, 213-24; (10) Wilson et al., "Effects of adenosine on human coronary arterial circulation," *Circulation,* 1990, 82, No. 5, 1595-606. The entire contents of each and every patent and non-patent publication cited herein are hereby incorporated by reference, except that in the event of any inconsistent disclosure or definition from the present specification, the disclosure or definition herein shall be deemed to prevail.

[0100] The foregoing detailed description and the accompanying drawings have been provided by way of explanation and illustration, and are not intended to limit the scope of the appended claims. Many variations in the presently preferred embodiments illustrated herein will be apparent to one of ordinary skill in the art, and remain within the scope of the appended claims and their equivalents.

[0101] It is to be understood that the elements and features recited in the appended claims may be combined in different ways to produce new claims that likewise fall within the scope of the present invention. Thus, whereas the dependent claims appended below depend from only a single independent or dependent claim, it is to be understood that these dependent claims can, alternatively, be made to depend in the alternative from any preceding claim—whether independent or dependent—and that such new combinations are to be understood as forming a part of the present specification.

1. A method for computing a hemodynamic quantity, the method comprising:
- acquiring angiography data from a patient;
- calculating, by a processor, a first flow in a blood vessel of the patient based on the angiography data;
- perturbing the first flow to a plurality of second flows;
- computing, by the processor, fractional flow reserve values from the first flow and the plurality of second flows;
- determining a sensitivity of the fractional flow reserve values to the perturbing; and
- reporting the sensitivity.

2. The method of claim **1** wherein computing comprises computing with a computational fluid dynamics model.

3. The method of claim **1** wherein calculating the first flow comprises calculating by motion tracking contrast agents representing in the angiography data.

4. The method of claim **3** wherein calculating comprises iteratively calculating the first flow.

5. The method of claim **4** wherein iteratively calculating comprises iteratively calculating until observed and measured time-intensity curves match.

6. The method of claim **1** wherein determining comprises determining relative to a baseline flow rate.

7. The method of claim **6** wherein the baseline flow rate comprises flow rate from artificially generated stenoses.

8. The method of claim **1** wherein calculating the first flow comprises calculating a third flow for a rest state, and calculating the first flow as a multiplication of the third flow by a flow rate scalar from the rest state to a hyperemic state, wherein the flow rate scalar comprises a rest-to-hyperemic flow rate ratio.

9. A method for computing a hemodynamic quantity, the method comprising:
- acquiring angiography data from a patient;
- calculating, by a processor, a first flow in a blood vessel of the patient based on the angiography data;
- perturbing the first flow to a plurality of second flows;
- computing, by the processor, values for the hemodynamic quantity from the first flow and the plurality of second flows;
- determining a sensitivity of the values of the hemodynamic quantity to the perturbing; and
- reporting the sensitivity.

10. The method of claim **9** wherein the hemodynamic quantity comprises a fractional flow reserve.

11. The method of claim **9** wherein computing comprises computing with a computational fluid dynamics model.

12. The method of claim **9** wherein calculating the first flow comprises calculating by motion tracking contrast agents representing in the angiography data.

13. The method of claim **12** wherein calculating comprises iteratively calculating the first flow.